

## **AMC TR-1 Transmitter/Receiver System**

### **Overview**

The AMC TR-1 transmitter/receiver system adds remote operation to the AMC Bumpcar Controller. The TR-1 system consists of TX-1 transmitter and RX-1 receiver. The TX-1 transmitter sends encoded start and stop signals at 433.92 MHz. The RX-1 receiver, which is connected to the Bumpcar Controller, decodes the signal and if the signal matches with the pre-selected pattern, sends a logic signal to the Bumpcar Controller. The TR-1 system has a range of 100 ~ 150 feet.

### **Installation and Operation of the TR-1**

Mount the RX-1 receiver at any convenient place on the bumper car. Connect the RX-1 and the Bumpcar Controller with the provided cable. The ends of the cable are both 5-pin male weather tight connectors. The Bumpcar Controller has two weather tight connectors, but they are gender specific. Connect the cable from the RX-1 receiver to the female 5-pin connector.

In order to activate the remote control, the user must set the slide switch S3 on the Bumpcar Controller to a correct position. Find S3 that is mounted near the center of the PC board. The label indicates local/rmt selection. Slide the switch to 'rmt' position.

The receiver RX-1 is ready when the main power switch on the Bumpcar Controller is turned on. The receiver always begins in off mode at power up and waits for a start signal.

Press start button on the TX-1 transmitter to start the car. As the button is pressed, a red LED on the panel turns on. This indicates that signal transmission is in progress. The bumper car ~~should now start~~. Press stop button in order to stop the car. The maximum duration of transmission is limit to about 1 second by a timer. If the operator keeps pressing the button, the LED will turn off in about a second. This is a normal behavior.

In starting or stopping a multiple number of cars, if one or two cars fail to respond, simply press the button again. This additional press does not affect the cars that have already responded to the command.

The user can select four different transmission channels by the setting of a two-position DIP switch (S1 on RX-1 and S2 on TX1). If there is an interference with some other remote control device, another channel may be tried. The switch settings on the transmitter and the receiver must match.

### **TX-1 Transmitter: Theory of Operation**

The TX-1 transmitter employs HT6015 3<sup>12</sup> series encoder chip (U4). HT6015 generates a 12 bits of encoded waveform from a 3 kHz square wave signal. Each bit takes one of the three states, one, zero, and open, depending on the state of the corresponding input of the HT6015 encoder (high, low, open). With HT6015, the first two bits, A0 and A1 are not accessible and are always in 'open' state. Bits A2 and A3 are selectable by a user either to 'one' or 'open' with a DIP switch. (This setting must match with that of the receiver.) Bits A4 ~ A7 are left open. Bits A8 and A9 are normally open but can be pulled

down to ground by a momentary contact switch S3 (start) and S4 (stop). These 10 bits make up the address code, which is used by the RX-1 transmitter to verify if the transmitter code is a valid start code, a valid stop code, or an invalid signal.

The transmitter is enabled only when D10 input is pulled low. This input is controlled by a MOSFET switch Q3. When either switch S3 (start) or S4 (stop) is closed, the timer chip LM555 (U6) turns on the MOSFET switch Q3 and the HT6015 begins transmission of the code. However, about a second later, the timer, whose timing is controlled by R6 and C7, expires and the output of the timer U6 turns low. This stops the transmission of the code. This limits the duration of the transmission. In practice, the user needs to press the button only momentarily to turn on or off the bumper car control's output.

A red LED on the transmitter indicates the actual transmission state of the HT6015. When the LED is off, HT6015 encoder is not active even when the button switch is pressed and the chip is powered.

The RF transmission is handled by TXM-433-LC. It transmits at 433.92 MHz only when its DATAIN input is high. The encoded logic signal from U4 is transformed into an encoded RF signal and transmitted via a quarter wave antenna.

The transmitter has a dual power inputs: a 9 V battery and a 9 Vdc wall mount power adapter.

## **RX-1 Receiver: Theory of Operation**

The receiver chip RXM-433-LC (U1) sends out a logic signal based on the absence and presence of the 433.92 MHz RF signal. When the encoded RF signal is successfully detected by U1, this will result in a train of logic level pulses that represent the encoded waveform. The decoder chip HT6035 (U2) compares the first 10-bits of the received encoded signal with its input states. If the code matches, it repeats the test. If the second test is also successful, U2 asserts VT output high momentarily. At the same time, the state of the last two bits (D10 and D11) of the 12-bit encoded signal will be latched to D10/D11 outputs. (This function, however, is not used in this system.) The VT output is sent to the Bumpcar Controller. The signal asserts an IRQ interrupt of the MCU in the Bumpcar Controller. The IRQ interrupt service code of the MCU toggles the output (turn off if it is previously on and vice versa.) At the same time, it changes the address status of the RX-1 so that once the output status is changed it will be latched.

When the system is first turned on, the controller's output is off and the address bits A8 and A9 of RX-1 are set as shown in Table I. The address code matches only when start button on TX-1 is pressed. Pressing stop button again has no effect because the transmitted code does not match with the address setting of RX-1. Once the transmitted code is validated, and the VT output is sent to the controller, the controller turns its output on and at the same time, change the address setting of the RX-1 as shown in Table I. Now, further pressing of start will not have any effect.

This method insures to start and stop a multiple number of bumper cars reliably simultaneously. If one or two cars fail to start by a signal transmission problem, for example, the operator can press start button again